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Laparoscopic colostomy for colorectal problems in children

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ABSTRACT

Purpose: To describe our experience in laparoscopic colostomy with separated stomas for colorectal issues in pediatric patients.

Methods: This prospective cohort, single-institution study included patients aged 0–18 years who exhibited colorectal problems requiring a colostomy and who were managed at a tertiary-level care hospital between October 2023 and September 2024.

Results: Fourteen patients were analyzed. Eleven (78 %) patients with anorectal malformation (ARM), 2 (14 %) with acquired rectal fistula, and 1 (7 %) with recurrent rectal fistula due to suspected inflammatory bowel disease. In total, 7 (63 %) of 11 patients with ARM underwent diversion during the neonatal period. Further, 4 (36 %) patients had diverted due to megarectum later in life. All patients underwent laparoscopic colostomy with separated stomas. The mean surgical duration was 114 (78–141) minutes. Enteral feeding was started at a mean of 1.7 [1–3] days postoperatively. The median length of hospital stay was 10.4 ([1]-51) days. There were no cases of stoma prolapse, wound infection, or skin excoriation. One (7 %) patient with a recto-vestibular fistula developed mucosal fistula stenosis at 90 days after colostomy.

Conclusions: Laparoscopic colostomy with separate stomas in children with colorectal problems is a safe, reproducible technique, with a lower risk of complications and with greater advantages compared with the open technique.

Introduction

Colostomy is a surgical procedure that is frequently performed for several colorectal disorders in pediatric patients. The optimal type of colostomy for these issues is a totally diverting colostomy with separated stomas, a method that diverts and avoids the passing of stool into the distal colon or rectum [1]. The open approach for the colostomy procedure itself is associated with a significant morbidity. The incidence rate of its associated complications ranges from 21 % to 58 %. The most common complications are mislocation of the stomas (extremely close to each other or too distally in the rectosigmoid that interferes with the pull-through), prolapse, skin dehiscence, stenosis, and retraction [2–8] (Fig. 1).

Peña described the following key points that should be considered to prevent colostomy-related complications during the procedure: 1) creation of separated stomas, 2) use of a portion of the colon fixed to the abdominal wall as a proximal stoma, 3) identification of the proximal, functional stoma as far away as possible from a prominence or structure that may interfere with the placement of a stoma bag, 4) creation of a mucous fistula tapering the last 2 or 3 cm of the distal colon and the tiny lumen to avoid prolapse, and 5) irrigation of the distal colon, which avoids the formation of a megarectosigmoid and decreases the risk of urinary tract infections in patients with recto-urinary fistulas [1].

In 1991, Lange et al. reported the first laparoscopic creation of a loop colostomy in a 48-year-old woman with stool incontinence [9]. In 2008, De Carli et al. published the first laparoscopic-assisted loop colostomy in children. This is a case series of three patients involving the use of a two-to-four port (3.5 mm) technique [10]. After 7 years, Gine et al. described a case series of six patients with anorectal malformation (ARM) using a two-port laparoscopic descending colostomy with separated stomas [11], which is based on the key concepts of colostomy creation as mentioned above [1]. The advantages of laparoscopic colostomy are similar to those of the open technique. Laparoscopic colostomy has added benefits. In particular, it is not associated with

Abbreviation: ARM, Anorectal malformation.

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wound-related complications and can be used to assess the internal genitalia [11,12].

The current study aimed to describe the use of a surgical technique and the performance of laparoscopic colostomy with separated stomas for colorectal issues in pediatric patients.

Materials and methods

Patients

This prospective cohort, single-institution study was conducted on patients aged 0–18 years who presented with colorectal problems requiring a colostomy and who were managed at a tertiary-level care hospital between October 2023 and September 2024.

Surgical technique

Under general anesthesia, the patient was placed in the supine position. The abdominal wall was washed, prepped, and draped. The sites of placement of both stomas were marked (Fig. 2-A). According to Dr. Alberto Peña's recommendations [1], the ideal stoma sites must be located as far away as possible from a prominence, irregularity, or structure that may interfere with the placement of a colostomy bag.

A right periumbilical incision was made, and a 3-mm trocar was placed into the abdominal cavity. The colon was dilated in most patients. Thus, this approach, rather than the method via the umbilicus or infraumbilical, was recommended as it provides an additional 1 cm of space for work. The 30° scope was introduced. The pneumoperitoneum was started using low flow at a rate of 2 l/min with pressure set at 6–7 mmHg (Fig. 2-B). Under direct visualization, the second 3-mm trocar was inserted in the proximal stoma site. A diagnostic laparoscopy was conducted, and the internal genitalia were inspected. The sigmoid was grasped at that particular point where the descending colon detaches from the left parieto-colic space and becomes mobile and was then exteriorized (which avoided proximal stoma prolapse) (Fig. 2-C). A 5–0 silk stich was placed where the bowel will be divided to secure to the colon (Fig. 2-D). The incision was extended to approximately 1 cm in a circular manner to allow for proper positioning of the stoma to prevent stenosis.

Before dividing the bowel, a 5–0 Vicryl purse-string suture was placed. An opening was made in the center, and a 12-Fr Foley catheter was introduced into the lumen to decompress the colon, thereby making it easier to manipulate (Fig. 2-E). In the same location where the purse-string suture was placed, two Baby Allen clamps were used to separate the bowel. Special attention was given to preserving the vascularity of the proximal and distal colon when handling the vessels. Tapering was made in the distal colon to create a mucous fistula. A stitch was placed in the mesentery window on the side of the distal colon, which was left referred to as it will be used later to close the mesentery window (Fig. 2-F).

A 0.3-cm circular incision was made at the mucous fistula site. Using the index finger, a clamp was guided through the abdominal cavity toward the proximal stoma site (Fig. 2-G).. Then, we took the distal colon, which is exteriorized to where the mucous fistula will be placed.

The pneumoperitoneum was restarted, and the proper position of both stomas was confirmed under direct visualization, paying special attention to the proximal stoma corresponding to the proximal sigmoid, right at the junction with the descending colon (Fig. 2-H). A 12-Fr Foley catheter was introduced into the distal stoma, which is sought toward the peritoneal reflection, thereby confirming its correct position.

The mesentery window was then closed by pulling on the stitch that was placed there and was fixed to the aponeurosis. The proximal stoma was meticulously constructed using the Brooke technique, and the distal stoma matured as a mucous fistula (Fig. 2-I). Before the colostomy bag was placed, the distal colon was irrigated with a warm saline solution for 20 min. Finally, the mucous fistula was dressed with gauze, and the colostomy bag was placed in the proximal stoma covering the mucous fistula.

Results

Fourteen patients were analyzed. Among them, 10 (71 %) were men (Table 1). Eleven (78 %) patients presented with ARM, two (14 %) with acquired rectal fistula, and one (7 %) with recurrent rectal fistula caused by suspected inflammatory bowel disease (Table 1).

In total, 7 (63 %) of 11 patients with ARM underwent diversion during the neonatal period. Their mean age was 2.42 (range: 1–9) days, and the mean weight was 2.6 (1.9–3.4) kilograms. All patients were born at term. One patient with type 1 esophageal atresia underwent laparoscopic gastrostomy during the same surgery. Four (36 %) patients with ARM underwent diversion later in life due to megarectum (recto-pelvic index >0.67), as observed in the contrast study of the recto-perineal ($n = 2$) and recto-vestibular ($n = 2$) malformations. Congenital heart disease was the most common finding in the VACTERL assessment of six (54 %) patients. Three (27 %) patients exhibited a tethered cord on spinal ultrasonography. Direct laparoscopic visualization did not show any alterations in the internal genitalia.

One (7 %) patient exhibited recurrent perineal fistula attributed to suspected inflammatory bowel disease, and they had failed conservative management. Further, two (14 %) patients with acquired rectal fistula, a complication of previous surgery, underwent colostomy diversion.

All patients underwent laparoscopic colostomy with separated

Fig. 1. Complications associated with colostomy procedure using the traditional open technique with separated stomas. A) Skin dehiscence and infection of the interestomal bridge. B) Distal stoma prolapse.

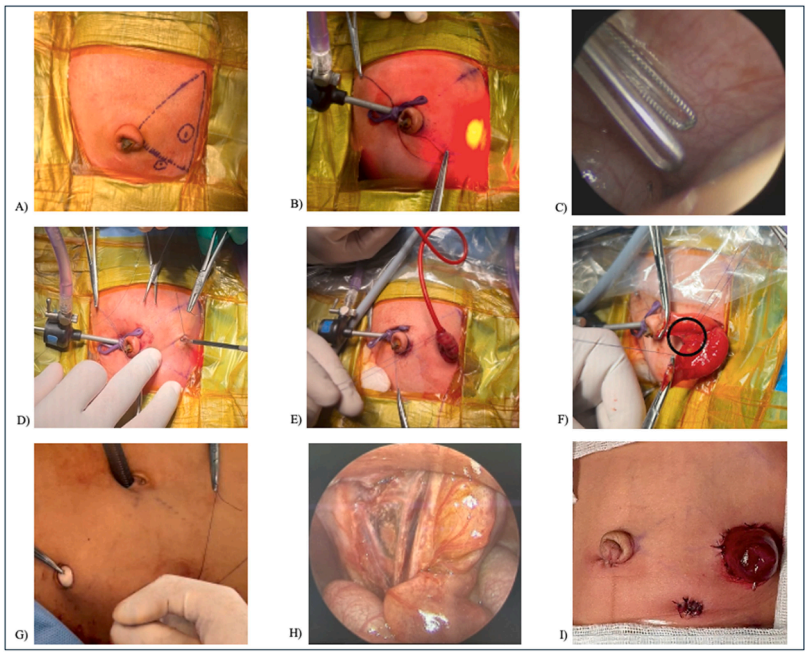

Fig. 2. Laparoscopic colostomy technique with separated stomas description. A) Sites where both stomas will be placed are marked. B) A right periumbilical incision is made and a 3-mm trocar is placed into the abdominal cavity. The 30° scope is introduced and pneumoperitoneum is started. Under direct visualization, the second 3-mm trocar is inserted in the proximal stoma site. C) A diagnostic laparoscopy is conducted and the internal genitalia are inspected. The sigmoid is grasped at the point where the descending colon detaches from the left parieto-colic space and becomes mobile and is then exteriorized. D) A 5–0 silk stich is placed where the bowel will be divided to secure to colon. The incision is extended to approximately 1 cm in a circular manner. E) Before dividing the bowel, a 5–0 Vicryl purse-string suture was placed. An opening was made in the center, and a 12-Fr Foley catheter was introduced into the lumen to decompress the colon. F) In the same location where the purse-string suture was placed, two Baby Allen clamps are used to separate the bowel. Tapering is made in the distal colon to create a mucous fistula. A stitch is placed in the mesentery window on the side of the distal colon, which is left referred to. G) Using the index finger, a clamp was guided through the abdominal cavity toward the proximal stoma site. Then, we took the distal colon, which is exteriorized to where the mucous fistula will be placed. H) Proper position of both stomas is confirmed under direct vision. I) The proximal stoma was meticulously constructed using the Brooke technique, and the distal stoma matured as a mucous fistula.

Table 1
Demographics and patient description.

n	Gender	Diagnosis	Weight (kg)	Age at surgery	Gestational weeks	VACTERL assessment	Operation Time	Enteral feeding (days postsurgery)	Lenght of stay (days)	Complications
1	F	ARM Cloaca	1.9	9 days	36	EA type *A* + TC + Hemivertebra	140	3	51	–
2	M	Rectourethral Bulbar	2.5	1 days	37	–	102	1	5	–
3	M	Rectourethral Bulbar	2.8	1 days	40	PFO	134	2	7	–
4	M	Rectourethral Bulbar	3.1	2 days	39	Right UTD	139	1	3	–
5	M	Rectourethral Bulbar	2.4	2 days	38	PFO + PDA + UTD bilateral	119	2	9	–
6	M	Rectourethral Bulbar	2.3	1 days	38	PDA	106	2	7	–
7	M	Scrotal recto -perineal Fistula	3.4	2 days	37	PDA + TC	103	2	4	–
8	F	Rectovestibular + Megarrectum	2.6	2 months	39	PFO + Right UTD + Vaginal agenesia + Uterus didelphys	118	2	3	Mucosal fistula stenosis
9	F	Rectovestibular + Megarrectum	6.3	2 months	38	Dextrocardia	124	1	2	–
10	M	Recto-perineal Fistula + Megarrectum	19	5 years	38	Right UPJO	78	1	2	–
11	M	Recto-perineal Fistula + Megarrectum	13	3 years	40	TC	92	2	3	–
12	M	Crohn's Disease	6	2 years	39	PDA	80	2	10	–
13	M	Acquired rectal fistula	20	6 years	38	–	132	1	14	–
14	F	Acquired rectal fistula	19	7 years	32	–	141	2	17	–

F: Female; M: Male; EA: esophageal atresia; PFO: Patent foramen ovale; PDA: patent ductus arteriosus; UTD: urinary tract dilation; UPJO; Ureteropielic junction obstruction; TC: Tethered cord.

stomas using the technique described earlier. The mean surgical duration was 114 (78–141) minutes. None of the patients developed intraoperative or anesthetic complications. Enteral feeding was started at a mean of 1.7 (1–3) days after the surgery. The median length of hospital stay was 10.4 (1–51) days. One patient with an extended hospital stay (51 days) had ARM and type 1 esophageal atresia. No complications were reported within the first 60 days after the surgery. One (7.6 %) patient with recto-vestibular fistula developed mucosal fistula stenosis at 90 days after colostomy. However, the patient did not require reintervention because the diagnosis was already made and a distal colostogram was not needed. There were no cases of stoma prolapse, wound infection, or skin excoriation.

Discussion

Colostomy is a surgical procedure that is commonly performed on pediatric patients with colorectal issues. The classic open technique with separate stomas has been the technique of choice for colorectal diseases, particularly in ARM.

This is because it prevents the passage of stool into the distal colon, which helps in the healing process of major surgery involving the rectum or genitourinary structures in the perineum. In addition, it prevents the development of fecaloma in the distal colon and decreases the rate of urinary tract infections [1,4].

The classical open approach has a high risk of complications. Prolapse of the stoma is the most frequent issue, followed by interstomal bridge infection. This represents a significant emotional, social, and economic impact on the family. The treatment of these problems includes wound and stoma management, broad-spectrum antibiotic therapy, prolonged hospitalization, and, in some cases, surgical reintervention [2–8]. In this study, there were no cases of stoma prolapse, wound infection, or skin excoriation. Meanwhile, in other reports, these complications were observed in 19 %, 6 %, and 15 % of patients, respectively [6,13].

Since its initial publication in 1991 [9], laparoscopic colostomy has been found to have numerous advantages over the open technique [9–12]. However, only two of the published studies followed the principles of a colostomy with separated stomas [11,12] described by Peña.

To the best of our knowledge, this is the largest series of laparoscopic colostomy procedures with separate stomas in children. The first five cases involved neonatal patients diagnosed with ARM. After identifying the benefits of the laparoscopic technique, the same approach has been used for other colorectal pathologies requiring a colostomy. In the procedure, only two ports were used: the umbilical one, where the camera is introduced, and the site where the proximal stoma will be placed. However, most patients with ARM who require a colostomy are neonates with an extremely distended sigmoid, which makes the working space minimal. In addition, inspection of the internal genitalia can be complicated when using two trocars. In these cases, adding a third trocar at the site of the distal stoma can be helpful without affecting the esthetic result. It should be emphasized that tapering was performed on the distal stoma in all cases to prevent distal colon prolapse.

We started enteral feeding if the stool output through the colostomy began, which occurred within the first 24–48 h after surgery. The length of hospital stay significantly differed due to the comorbidities of each patient. The first patient aged 9 days old was referred to our institution and was diagnosed with a 2-cm common channel cloaca and type 1 esophageal atresia. During the same surgery, laparoscopic colostomy and gastrostomy were conducted. After 4 weeks, the patient underwent esophageal plasty and was finally discharged at 51 days of life. Meanwhile, laparoscopic colostomy was performed on two patients with acquired rectal fistulas, and none of the patients developed complications. However, due to the complication from the prior rectal surgery, they remained in the hospital for the completion of the antibiotic regimen. Similarly, another patient with a rectal abscess and recurrent rectal fistula was suspected of inflammatory bowel disease, and this patient completed a 7-day antibiotic treatment after the colostomy.

This study included four patients aged >3 years who did not have a previous history of medical or surgical treatment. These patients were diagnosed with ARM and were referred to our institution. As part of our preoperative approach in these patients, fistulogram was performed, and results revealed a megarectum that was characterized by a rectopelvic index >0.65. Therefore, laparoscopic colostomy was initially performed, followed by a posterior sagittal anorectoplasty in the second surgical stage. Another reason for selecting initial colostomy is that our patients are low-income individuals residing in remote rural areas, which are far away from the nearest hospital. In addition, the quality of wound care for a posterior sagittal incision may not be optimal in their circumstances.

In all cases, the distal colon was cleaned for 20 min until the sigmoid was free of meconium. The surgical duration was dependent on several factors such as the diagnosis, age, and weight of the patients. In the two cases of acquired rectal fistula, the intestinal content was found in the abdominal cavity, and peritoneal lavage was conducted, which increased the surgical time in these cases. Another factor that contributed to the condition was that the same attending conducted the first seven procedures, and four different residents performed the last seven. Thus, the technique is reproducible. However, similar to other laparoscopic procedures, it requires a learning curve.

The re-use of the loop colostomy technique is currently being discussed [13,14]. Ramirez-Amoros et al. published their experience with colostomy procedures performed using the classic open approach with separate stomas and those performed using laparoscopic loops. Similar to our study, they found significant advantages over the open technique [15]. The recent literature did not show a greater risk of urinary tract infections caused by leaving a loop colostomy [13–15]. Nevertheless, based on our experience, we have observed the opposite, along with the formation of fecalomas in the distal colon. Therefore, it is essential to follow the principles for creating a colostomy that were established by Peña [1].

The laparoscopic technique for a colostomy creation with separated stomas has several advantages over the open approach. These include the following:

1. It eliminates the risk of infection and dehiscence of the interstomal bridge as there is no such bridge. In addition, since there are no sutures and interstomal bridge, it is easier for the family to place and change the colostomy bag.
2. Direct laparoscopic visualization of the internal genitalia, which is crucial for determining the appropriate surgical approach, particularly in girls with ARM and vaginal agenesis.
3. It confirms the correct location of both the proximal and distal stoma via direct laparoscopic visualization.
4. It allows for the performance of another abdominal procedure, such as the creation of a gastrostomy, during the same surgery.
5. The same attending physician performed the first seven procedures. A colorectal surgical resident conducted the subsequent three procedures, and final-year pediatric surgical residents performed the last four procedures. This demonstrates the reproducibility of the technique.
6. It lowers the risk of developing intraabdominal adhesions.
7. It results in better esthetic outcomes.

The current study had some limitations. First, it included a prospective cohort and a small sample size of patients. Secondly, a 60-day follow-up period is insufficient to fully assess the complications reported in the existing literature. Therefore, in the future, an experimental, randomized, double-blind clinical trial should be conducted to compare laparoscopic colostomy with separate stomas and loop colostomy.

Conclusion

In children with colorectal issues, laparoscopic colostomy with separate stomas is a safe, reproducible technique, with a lower risk of complications and with greater advantages compared with the open technique.

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CRediT authorship contribution statement

A. Domínguez-Muñoz: Writing – review & editing, Writing – original draft, Validation, Supervision, Investigation, Formal analysis, Conceptualization. **A. Costa-Roig:** Writing – original draft, Resources, Methodology, Formal analysis. **E. Fernández-Portilla:** Visualization, Validation, Formal analysis. **J. Nieto-Zermeño:** Validation, Supervision, Resources, Data curation, Conceptualization. **E. Bracho-Blanchet:** Methodology, Formal analysis. **I. Lizárraga-Rodríguez:** Visualization, Validation, Investigation. **J. Salazar-Rivera:** Methodology, Investigation, Formal analysis. **R. Dávila-Pérez:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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